

WHAT IS CLAIMED IS:

1. An air filter system for filtering a flow of intake air for a combustion engine, said filter system comprising:

a tubular housing having an inlet arranged in the housing for introducing unfiltered air to be cleaned by filtration, an outlet arranged in the housing for discharging clean filtered air, and an opening for changing the filter;

a cover for closing the filter changing opening; and

a filter arrangement between the inlet and the outlet such that air from the inlet must pass in a direction of flow through the filter arrangement to reach the outlet;

wherein said filter arrangement comprises at least one prefilter, one main filter and one secondary filter arranged in axial succession in the direction of flow in the housing.

2. A filter system according to claim 1, wherein the prefilter comprises at least two parallel cyclone separators, the main filter is an annular filter element, and the secondary filter is also an annular filter element, and wherein the main filter has a first end disk in the direction of flow which is closed and carries a handle, and the secondary filter has a second end disk in the direction of flow which is closed.

3. A filter system according to claim 2, wherein the flow of air passes through the main filter element from the outside to the inside, and, downstream from the main filter, the flow of air passes through the secondary filter from the inside to the outside.

4. A filter system according to claim 2, wherein the main filter is arranged substantially at the axial center of the tubular housing, and the secondary filter is disposed on the main filter downstream from the main filter in the direction of flow so as to be coaxial with the main filter, and

wherein an annular connecting profile is provided in the housing between main filter and the secondary filter for connecting the two filters.

5. A filter system according to claim 4, wherein the annular connecting profile has radial sealing surfaces and axial stop surfaces, said radial sealing surfaces sealing the main filter and the secondary filter for separating a clean air side from an unfiltered air side, and said axial stop surfaces defining final axial positions of the main filter and the secondary filter.

6. A filter system according to claim 2, wherein downstream from the at least two parallel cyclones in the interior of the housing a channel is situated which is sealed off from the remainder of the interior volume of the housing, said channel being connected to a vacuum source downstream from the housing in order to discharge solid particles separated by the cyclone.

7. A filter system according to claim 1, wherein said cover includes position fixing means for preventing improper installation of at least one filter element and changes in position of said at least one filter element during operation.

8. A filter system according to claim 7, wherein said position fixing means comprises a radially inwardly extending curved portion on said cover.

9. A filter system according to claim 1, wherein the inlet has a variable size inlet opening, and the separation efficiency of the prefilter is matched to the size of the inlet opening.

10. A filter system according to claim 1, wherein said housing further comprises means for accommodating functional elements, and

means are provided in the interior of the housing for optionally supplying electrical power to said functional elements from an electrical power source arranged outside the housing.

11. A filter system according to claim 10, wherein said functional elements comprise a lighting device or a rear view mirror.

12. A filter system according to claim 1, wherein the housing is made of centrifugally cast synthetic resin material.

13. A filter system according to claim 1, wherein said housing is formed primarily by an A pillar of a motor vehicle.

14. A filter system according to claim 1, wherein said housing is formed primarily by body parts or frame parts of a motor vehicle.

15. A filter system according to claim 1, wherein the housing is constructed as an external free-standing or horizontal element freely mountable on a motor vehicle body or on an internal combustion engine of a motor vehicle.

16. A main filter element for a filter system according to claim 1, wherein said main filter element is an annular filter element with a first end disk in the direction of flow which is closed and which carries an axially extending handle, and with a second end disk having a radially acting resilient gasket in a circumferential groove for sealingly contacting a radial sealing surface on the connecting element in the housing.

17. A main filter element according to claim 16, wherein said filter element comprises a filter medium made of zig-zag folded pleated filter; the end disks are made of a thermoplastic synthetic resin material, and the radially acting gasket has a T-shaped cross section.

18. A secondary filter element for a filter system according to claim 1, wherein said secondary filter element is an annular filter element with a first end disk in the direction of flow which carries an axially extending handle and which has a resilient radial gasket in a circumferential groove for sealingly contacting a radial sealing surface on the connecting element in the housing, and with a second end disk which is closed.

19. A secondary filter element according to claim 18, wherein said filter element comprises a filter medium made of non-woven fibers; the end disks are made of a thermoplastic synthetic resin material, and wherein the radial gasket has a T-shaped cross section.

20. A method of cleaning intake air for an internal combustion engine, said method comprising:

passing uncleaned air through a cyclone separator,

discharging particles separated from the air in the cyclone separator through a line which extends through a filter housing without allowing the particles to enter the interior of the filter housing,

subsequently passing precleaned air from the cyclone separator radially through a main filter element from the outside to the inside,

thereafter passing air from the main filter element radially through a secondary filter element from the inside to the outside, and

forwarding filtered clean air from the secondary filter element to the engine;

wherein said secondary filter element is connected axially to said main filter element, has a closed second end disk in the direction of flow, and captures any large particles remaining in the air which has passed through the cyclone and main filter.